

Chapter One: Measurement

- 1.1 Measurements
- 1.2 Time and Distance
- 1.3 Converting Measurements
- 1.4 Working with Measurements

Investigation 1A Measurement

- **Key Question:**
Are you able to use scientific tools to make accurate measurements?



1.1 Measurements

- A **measurement** is a determination of the amount of something.
- A measurement has two parts:
 - a **number value** and
 - a **unit**



1.1 Two common systems

- The **English System** is used for everyday measurements in the United States.
- Miles, yards, feet, inches, pounds, pints, quarts, gallons, cups, and teaspoons are all English system units.
- In 1960, the Metric System was revised and simplified, and a new name was adopted—International System of Units.

1.1 International System of Measurement (SI)

- The acronym *SI* comes from the French name *Le Système International d'Unités*.
- *SI* units form a base-10 or decimal system.
- In the metric system, there are:
 - 10 millimeters in a centimeter,
 - 100 centimeters in a meter, and
 - 1,000 meters in a kilometer.

1.1 The meter stick

- A meter stick is 1 meter long and is divided into millimeters and centimeters.



1.1 The meter stick

- Each centimeter is divided into ten smaller units, called millimeters.



What is the length in cm?

Solve first Look later

Common SI Units

Measurement	Unit	Value
LENGTH		
width of pinky finger = 1 cm	meter (m)	
	kilometer (km)	1 km = 1,000 m
	decimeter (dm)	1 dm = 0.1 m
	centimeter (cm)	1 cm = 0.01 m
	millimeter (mm)	1 mm = 0.001 m
	micrometer (μm)	1 μm = 0.000001 m
	nanometer (nm)	1 nm = 0.000000001 m
VOLUME		
10 drops of water = 1 mL	cubic meter (m ³)	
	cubic centimeter (cm ³)	1 cm ³ = 0.000001 m ³
	liter (L)	1 L = 0.001 m ³
	milliliter (mL)	1 mL = 0.001 L
WEIGHT		
1 large paper clip = 1 gram	kilogram (kg)	
	gram (g)	1 g = 0.001 kg
	milligram (mg)	1 mg = 0.000001 kg
TEMPERATURE		
21° C = room temperature	Kelvin (K)	0°C = 273 K
	Celsius (°C)	100°C = 373 K

1.2 Distance



- **Distance** is the amount of space between two points.
- Distance is measured in units of **length**.
- The **meter** is a basic SI distance unit.

In 1791, a meter was defined as one ten-millionth of the distance from the North Pole to the equator. What standard is used today?

1.2 Metric prefixes

- Prefixes are added to the names of basic SI units such as meter, liter and gram.
- Prefixes describe very small or large measurements.

Prefix	Prefix + meter	Compared to 1 meter
kilo-	kilometer	1,000 times bigger
centi-	centimeter	100 times smaller
milli-	millimeter	1,000 times smaller

Bytes and SI Prefixes

BYTE One unit of computer storage	8 bits	1 character - anything you type on a keyboard
KILOBYTE 1000 bytes	1/2 page of text	One Apollo on-board computer (1968) = 74 KB of memory
MEGABYTE One million bytes	One minute of music	500 pages of text
GIGABYTE One billion bytes	18 hours of mp3 music	12 hours of flash video
TERABYTE One trillion bytes	Library of Congress has about 10 TB of print collections	Superstore data warehouse has about 9000 TB of data
PETABYTE One quadrillion bytes	Internet search engine processes 20 PB per day	All emails sent in the world in 2002 = 440 PB

SI Prefixes for Decimal Multiples

Number	Factor	Name	Symbol
1 000 000 000 000 000	10^{15}	peta	P
1 000 000 000 000	10^{12}	tera	T
1 000 000 000	10^9	giga	G
1 000 000	10^6	mega	M
1 000	10^3	kilo	k
100	10^2	hecto	h
10	10^1	deca	da
0.1	10^{-1}	deci	d
0.01	10^{-2}	centi	c
0.001	10^{-3}	milli	m
0.000 001	10^{-6}	micro	μ
0.000 000 001	10^{-9}	nano	n
0.000 000 000 001	10^{-12}	pico	p

1.3 Converting units

➤ To convert 1,565 pennies to the dollar amount, you divide 1,565 by 100 (since there are 100 pennies in a dollar).

➤ Converting SI units is just as easy as converting pennies to dollars.



Convert 142 km to m

Looking for: the distance in meters

Given: distance = 142 kilometers

Relationships: There are ? meters in 1 kilometer?

Solution: Use the conversion tool.

142 km =



Solving Problems

➤ Convert 655 mm to m

Looking for:

655 mm =

Given:

Relationships:

Solution:



Solving Problems

Convert 754,000 cm to km

Looking for:

754,000 cm =

Given:

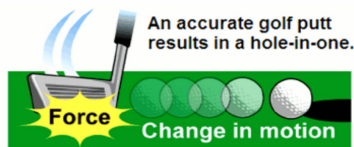
Relationships:

Solution:



1.4 Working with Measurements

- **Accuracy** is how close a measurement is to the accepted, true value.
- **Precision** describes how close together repeated measurements or events are to one another.



An accurate golf putt results in a hole-in-one.

Why is precision important in golf?

1.4 Resolution



Low resolution

High resolution

- **Resolution** refers to the smallest interval that can be measured.
- You can think of resolution as the “sharpness” of a measurement.

1.4 Working with Measurements



- In the real world it is *impossible* for everyone to arrive at the exact same true measurement as everyone else.

Find the length of the object in centimeters.

How many digits does your answer have?